CHAPTER 11

RADIOACTIVE WASTE MANAGEMENT

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CHAPTER 11

RADIOACTIVE WASTE MANAGEMENT

11.1 SOURCE TERMS

This section of the referenced DCD is incorporated by reference with no departures or supplements.

11.2 LIQUID WASTE MANAGEMENT SYSTEM

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

11.2.1.2.5.2 Use of Mobile and Temporary Equipment

Add the following information at the end of DCD Subsection 11.2.1.2.5.2:

HAR COL 11.2-1 When mobile or temporary equipment is selected to process liquid effluents, the equipment design and testing meets the applicable requirements of Regulatory Guide 1.143. When confirmed through sampling that the radioactive waste contents do not exceed the A_2 quantities for radionuclides specified in Appendix A to 10 CFR Part 71, the liquid effluent may be processed in the Radwaste Building. When the A_2 quantities are exceeded, the liquid effluent is processed in the Seismic Category I Auxiliary Building.

STD COL 11.2-1 Mobile or temporary equipment is designed in accordance with the codes and standards listed in Table 1 and Regulatory Position C.1.1.2 of Regulatory Guide 1.143.

Mobile or temporary equipment has the following features:

- Level indication and alarms (high-level) on tanks.
- Screwed connections are permitted only for instrument connections beyond the first isolation valve.
- Remote operated valves are used where an Operator would be required to frequently manipulate a valve.
- Local control panels are located away from the equipment, in low dose areas.
- Instrumentation readings are accessible from the local control panels (i.e., temperature, flow, pressure, liquid level, etc.).
- Wetted parts are 300 series stainless steel, except flexible hose and gaskets.
- Flexible hose is used only for mobile equipment within the designated “black box” locations between mobile components and at the interface with the permanent plant piping.
- The contents of tanks are capable of being mixed, either through recirculation or with a mixer.

- Grab sample points are located in tanks and upstream and downstream of the process equipment.

Inspection and testing of mobile or temporary equipment is in accordance with the codes and standards listed in Table 1 of Regulatory Guide 1.143 with the following additions:

- After placement in the station, the mobile or temporary equipment is hydrostatically, or pneumatically, tested prior to tie-in to permanent plant piping.
- A functional test, using demineralized water, is performed. Remote operated valves are stroked (open-closed-open or closed-open-closed) under full flow conditions. The proper function of the instrumentation, including alarms, is verified. The operating procedures are verified correct during the functional test.
- Tank overflows are routed to floor drains.
- Floor drains are confirmed to be functional prior to placing mobile or temporary equipment into operation.

11.2.3.4 Release Concentrations

Add the following information at the end of DCD Subsection 11.2.3.4.

HAR SUP 11.2-1

To demonstrate compliance with the Reference 1 effluent concentration limits, the discharge concentrations have been evaluated for the release of the annual expected activity diluted with the average annual discharge flow of 20 cfs for 292 days from Harris Lake to Cape Fear River. The dilution factors are presented in Table 11.2-201. Table 11.2-204 lists the annual average nuclide release concentrations and the fraction of the effluent concentration limits using base GALE code assumptions. As shown in Table 11.2-204, the overall fraction of the effluent concentration limit is 0.15, which is below the allowable value of 1.0.

The annual releases from the plant have also been evaluated based on operation with the maximum defined fuel defect level. The maximum defined fuel defect level corresponds to the Technical Specification limit on coolant activity which is based on 0.25 percent fuel defects. Table 11.2-205 lists the annual average nuclide release concentrations and the fractions of the effluent concentration limits for the maximum defined fuel defects. As shown in Table 11.2-205, the overall fraction of the effluent concentration limit for the maximum defined fuel defect level is 0.69, which is below the allowable value of 1.0.

11.2.3.5 Estimated Doses

Replace the information in DCD Subsection 11.2.3.5 with the following paragraphs and subsections.

HAR COL 11.2-2 Dose and dose rate to man was calculated using the LADTAP II computer code. This code is based on the methodology presented in Regulatory Guide 1.109.

HAR COL 11.5-3 Factors common to both estimated individual dose rates and estimated population dose are addressed here. Unique data are discussed in the respective sections.

Activity pathways considered are drinking water, sport fishing, and recreational activities.

The nearest drinking water takeoff downstream of the Harris site is approximately seventeen miles downstream at the town of Lillington.

11.2.3.5.1 Estimated Individual Dose Rates

Dose rates to individuals are calculated for drinking water, fish consumption, and recreational activities.

Drinking water produced a maximum dose rate to a single organ of 1.41E-1 mrem/yr to a child's liver. The maximum total body dose rate was calculated to be 1.35E-1 mrem/yr to a child.

Fish consumption assumes that fish are caught at the plant discharge. LADTAP II default fish consumption values are used in lieu of site-specific fish consumption data. The estimated maximum dose rate to a single organ is 3.04 mrem/yr to a teenager's liver. The maximum total body dose rate is calculated to be 1.98 mrem/yr to an adult.

Shoreline recreation results in a maximum dose rate to a single organ of 2.44E-2 mrem/yr to a teenager's skin. The maximum total body dose rate is calculated to be 2.1E-2 mrem/yr to a teenager.

The maximum dose rate to any organ considering all pathways was calculated to be 3.14 mrem/yr to a teenager's liver. The maximum total body dose rate is calculated to be 2.09 mrem/yr to an adult.

Table 11.2-202 contains LADTAP II input data for dose rate calculations. Table 11.2-203 contains total organ dose rates based on age group.

11.2.3.5.2 Estimated Population Dose

The pathway for the population dose to the 81 km (50 mile) residents is for the several downstream municipal water intakes at Lillington, Erwin, and Fayetteville (Subsection 2.4.1.2.7). The municipal populations are listed in Table 11.2-201.

The estimated population dose within 81 km (50 miles) is calculated as 6.8 person-rem whole body and 6.6 person-rem thyroid.

11.2.3.6 Quality Assurance

Add the following to the end of DCD Subsection 11.2.3.6:

STD SUP 11.2-1

Since the impact of radwaste systems on safety is limited, the extent of control required by Appendix B to 10 CFR Part 50 is similarly limited. Thus, a supplemental quality assurance program applicable to design, construction, installation and testing provisions of the liquid radwaste system is established by procedures that complies with the guidance presented in Regulatory Guide 1.143.

11.2.5 COMBINED LICENSE INFORMATION

11.2.5.1 Liquid Radwaste Processing by Mobile Equipment

STD COL 11.2-1
HAR COL 11.2-1

This COL Item is addressed in Subsection 11.2.1.2.5.2.

11.2.5.2 Cost Benefit Analysis of Population Doses

HAR COL 11.2-2

This section adopts NEI 07-11 (Reference 201). This document is currently under review by the NRC staff. The augments provided in NEI 07-11 were reviewed and were found not to be cost beneficial due to the low HAR 2 and 3 population doses.

11.2.6 REFERENCES

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201. NEI 07-11, “Generic Template Guidance for Cost Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors,” Revision 0, September 2007.

HAR COL 11.2-2

Table 11.2-201
Dilution Factors and Population Data

Parameter	Average Annual Condition
Discharge Flow From Harris Lake to Cape Fear River (cfs)	20
Distance to Drinking Extraction (mi.)	17(Lillington)
Dilution Factor for Drinking	13.9 (Lillington)[(a)]
Dilution Factor for Recreational	1
Dilution Factor for Fish	1
Lillington Population	2915
Erwin Population	4537
Fayetteville Population	121,015

a) Dilution Factor for Lillington conservatively used for Erwin and Fayetteville even though both are further downstream with more dilution and longer transit times.

HAR COL 11.2-2

Table 11.2-202
LADTOP II Input for Individual Dose Rates

Input Parameter	Value
Freshwater Site	Selected
Discharge Flow Rate from two AP1000 units to Harris Lake (gpm)	12,000
50-Mile Population	2,029,925
Source Term	DCD Table 11.2-7
Reconcentration Model	Partial Mixing
Shore Width Factor	0.3
Dilution Factors	Table 11.2-201
Transit Time – Drinking (h)	12.0
Transit time – Fish and Recreational Uses (h)	0

HAR COL 11.2-2

Table 11.2-203
Individual Dose Rates [(a)]

	Dose (mrem/yr)							
Age Group	**Skin**	**Bone**	**Liver**	**Total Body**	**Thyroid**	**Kidney**	**Lung**	**GI-LLI**
Adult	4.38E-03	2.05E+00	3.05E+00	2.09E+00	1.38E-01	1.12E+00	4.65E-01	1.97E-01
Teenager	2.44E-02	2.20E+00	3.14E+00	1.20E+00	1.18E-01	1.14E+00	5.14E-01	1.62E-01
Child	5.11E-03	2.75E+00	2.88E+00	5.78E-01	1.61E-01	1.04E00	4.78E-01	1.78E-01
Infant	0.00E+00	7.82E-03	1.40E-01	1.32E-01	1.31E-01	1.34E-01	1.32E-01	1.31E-01

a) Dose rates represent the summation of dose rates from each pathway.

HAR SUP 11.2-1

Table 11.2-204 (Sheet 1 of 3)
Comparison of Annual Average Liquid Release Concentrations with 10 CFR 20 Effluent Concentration Limits for Expected Releases – Two Units

Nuclide	Discharge Concentration (μCi/ml)[a]	Effluent Concentration Limit (μCi/ml)[b]	Fraction of Concentration Limit
Na-24	2.3E-10	5.0E-05	4.6E-06
Cr-51	2.6E-10	5.0E-04	5.2E-07
Mn-54	1.8E-10	3.0E-05	6.1E-06
Fe-55	1.4E-10	1.0E-04	1.4E-06
Fe-59	2.8E-11	1.0E-05	2.8E-06
Co-58	4.7E-10	2.0E-05	2.4E-05
Co-60	6.2E-11	3.0E-06	2.1E-05
Zn-65	5.7E-11	5.0E-06	1.1E-05
W-187	1.8E-11	3.0E-05	6.1E-07
Np-239	3.4E-11	2.0E-05	1.7E-06
Br-84	2.8E-12	4.0E-04	7.0E-09
Rb-88	3.8E-11	4.0E-04	9.4E-08
Sr-89	1.4E-11	8.0E-06	1.7E-06
Sr-90	1.4E-12	5.0E-07	2.8E-06
Sr-91	2.8E-12	2.0E-05	1.4E-07
Y-91m	1.4E-12	2.0E-03	7.0E-10
Y-93	1.3E-11	2.0E-05	6.3E-07
Zr-95	3.2E-11	2.0E-05	1.6E-06
Nb-95	2.9E-11	3.0E-05	9.8E-07
Mo-99	8.0E-11	2.0E-05	4.0E-06
Tc-99m	7.7E-11	1.0E-03	7.7E-08

HAR SUP 11.2-1

Table 11.2-204 (Sheet 2 of 3)
Comparison of Annual Average Liquid Release Concentrations with 10 CFR 20 Effluent Concentration Limits for Expected Releases – Two Units

Nuclide	Discharge Concentration (μCi/ml)[a]	Effluent Concentration Limit (μCi/ml)[b]	Fraction of Concentration Limit
Ru-103	6.9E-10	3.0E-05	2.3E-05
Rh-103m	6.9E-10	6.0E-03	1.2E-07
Ru-106	1.0E-08	3.0E-06	3.4E-03
Ag-110m	1.5E-10	6.0E-06	2.4E-05
Te-129m	1.7E-11	7.0E-06	2.4E-06
Te-129	2.1E-11	4.0E-04	5.2E-08
Te-131m	1.3E-11	8.0E-06	1.6E-06
Te-131	4.2E-12	8.0E-05	5.2E-08
I-131	2.0E-09	1.0E-06	2.0E-03
Te-132	3.4E-11	9.0E-06	3.7E-06
I-132	2.3E-10	1.0E-04	2.3E-06
I-133	9.4E-10	7.0E-06	1.3E-04
I-134	1.1E-10	4.0E-04	2.8E-07
Cs-134	1.4E-09	9.0E-07	1.5E-03
I-135	7.0E-10	3.0E-05	2.3E-05
Cs-136	8.8E-11	6.0E-06	1.5E-05
Cs-137	1.9E-09	1.0E-06	1.9E-03
Ba-140	7.7E-10	8.0E-06	9.7E-05
La-140	1.0E-09	9.0E-06	1.2E-04
Ce-141	1.3E-11	3.0E-05	4.2E-07
Ce-143	2.7E-11	2.0E-05	1.3E-06

HAR SUP 11.2-1

Table 11.2-204 (Sheet 3 of 3)
Comparison of Annual Average Liquid Release Concentrations with 10 CFR 20 Effluent Concentration Limits for Expected Releases – Two Units

Nuclide	Discharge Concentration (μCi/ml)[a]	Effluent Concentration Limit (μCi/ml)[b]	Fraction of Concentration Limit
Pr-143	1.8E-11	7.0E-05	2.6E-07
Ce-144	4.4E-10	3.0E-06	1.5E-04
Pr-144	4.4E-10	2.0E-05	2.2E-05
H-3	1.4E-04	1.0E-03	1.4E-01
			Total = 0.15

Notes:
a) Annual average discharge concentration based on release of average daily discharge for 292 days per year with 20 ft^3/sec dilution flow.
b) Effluent concentration limits are from 10 CFR 20, Appendix B.

HAR SUP 11.2-1

Table 11.2-205 (Sheet 1 of 3)
Comparison of Annual Average Liquid Release Concentrations with 10 CFR 20 Effluent Concentration Limits for Releases with Maximum Defined Fuel Defects – Two Units

Nuclide	Discharge Concentration (μCi/ml)[(a)]	Effluent Concentration Limit (μCi/ml)[(b)]	Fraction of Concentration Limit
Na-24	2.3E-10	5.0E-05	4.5E-06
Cr-51	2.1E-10	5.0E-04	4.3E-07
Mn-54	1.9E-10	3.0E-05	6.2E-06
Fe-55	1.3E-10	1.0E-04	1.3E-06
Fe-59	2.8E-11	1.0E-05	2.8E-06
Co-58	4.7E-10	2.0E-05	2.3E-05
Co-60	6.1E-11	3.0E-06	2.0E-05
Zn-65	5.7E-11	5.0E-06	1.1E-05
W-187	1.9E-11	3.0E-05	6.2E-07
Np-239	3.3E-11	2.0E-05	1.7E-06
Br-84	6.1E-12	4.0E-04	1.5E-08
Rb-88	3.9E-10	4.0E-04	9.7E-07
Sr-89	2.4E-10	8.0E-06	3.0E-05
Sr-91	1.2E-11	2.0E-05	6.1E-07
Y-91m	9.4E-12	2.0E-03	4.7E-07
Y-93	1.6E-11	2.0E-05	8.0E-09
Zr-95	5.7E-11	2.0E-05	2.9E-06
Nb-95	6.1E-11	3.0E-05	3.1E-06
Mo-99	7.2E-09	2.0E-05	2.4E-04
Tc-99m	6.5E-09	1.0E-03	3.3E-04
Ru-103	4.5E-10	3.0E-05	4.5E-07

HAR SUP 11.2-1

Table 11.2-205 (Sheet 2 of 3)
Comparison of Annual Average Liquid Release Concentrations with 10 CFR 20 Effluent Concentration Limits for Releases with Maximum Defined Fuel Defects – Two Units

Nuclide	Discharge Concentration (μCi/ml)[(a)]	Effluent Concentration Limit (μCi/ml)[(b)]	Fraction of Concentration Limit
Rh-103m	4.5E-10	6.0E-03	1.5E-05
Ru-106	2.1E-08	3.0E-06	3.6E-06
Ag-110m	1.9E-10	6.0E-06	6.2E-05
Te-129m	5.2E-10	7.0E-06	7.4E-05
Te-129	2.1E-11	4.0E-04	5.3E-08
Te-131m	9.9E-11	8.0E-06	1.2E-05
Te-131	5.3E-12	8.0E-05	6.7E-08
I-131	1.6E-08	1.0E-06	1.6E-02
Te-132	3.1E-09	9.0E-06	3.4E-04
I-132	4.8E-10	1.0E-04	4.8E-06
I-133	4.4E-09	7.0E-06	6.3E-04
I-134	1.1E-10	4.0E-04	2.8E-07
Cs-134	2.7E-07	9.0E-07	3.0E-01
I-135	1.2E-09	3.0E-05	4.1E-05
Cs-136	2.0E-07	6.0E-06	3.3E-02
Cs-137	2.0E-07	1.0E-06	2.0E-01
Ba-140	7.8E-10	8.0E-06	9.7E-05
La-140	1.0E-09	9.0E-06	1.2E-04
Ce-141	3.9E-11	3.0E-05	1.3E-06
Ce-143	2.7E-11	2.0E-05	1.3E-06
Pr-143	1.9E-11	7.0E-05	2.7E-07

HAR SUP 11.2-1

Table 11.2-205 (Sheet 3 of 3)
Comparison of Annual Average Liquid Release Concentrations with 10 CFR 20 Effluent Concentration Limits for Releases with Maximum Defined Fuel Defects – Two Units

Nuclide	Discharge Concentration (μCi/ml)[(a)]	Effluent Concentration Limit (μCi/ml)[(b)]	Fraction of Concentration Limit
Ce-144	4.4E-10	3.0E-06	1.5E-04
Pr-144	4.4E-10	2.0E-05	2.2E-05
H-3	1.4E-04	1.0E-03	1.4E-01
			Total = 0.69

Notes:
a) Annual average discharge concentration based on release of average daily discharge for 292 days per year with 20 ft^3/sec dilution flow.
b) Effluent concentrations limits are from 10 CFR 20, Appendix B.

11.3 GASEOUS WASTE MANAGEMENT SYSTEM

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

11.3.3.4 Estimated Doses

Add the following information at the end of DCD Subsection 11.3.3.4.

HAR COL 11.3-1

HAR COL 11.5-3

The HAR site-specific values are bounded by the DCD identified acceptable releases. With the annual airborne releases listed in DCD Table 11.3-3, the site-specific air doses at ground level at the exclusion area boundary are 0.97 mrad for gamma radiation and 4.47 mrad for beta radiation. These doses are based on the annual average atmospheric dispersion factor from FSAR Section 2.3. These doses are below the 10 CFR Part 50, Appendix I design objectives of 10 mrad per year for gamma radiation or 20 mrad per year for beta radiation.

Dose and dose rate to man was calculated using the GASPAR II computer code. This code is based on the methodology presented in the Regulatory Guide 1.109. Factors common to both estimated individual dose rates and estimated population dose are addressed in this subsection. Unique data are discussed in the respective subsections.

Activity pathways considered are plume, ground deposition, inhalation, and ingestion of vegetables, meat, and milk (both cow and goat).

Based on site meteorological conditions, the highest rate of plume exposure and ground deposition occurs at the exclusion area boundary (EAB) 1.25 km (0.77 mi.) SSW of the plant.

Agricultural products are estimated from U. S. Department of Agriculture (USDA) National Agricultural Statistics Service.

Population distribution within 81 km (50-mi.) radius is presented in FSAR Tables 2.1.3-202 and 2.1.3-204.

11.3.3.4.1 Estimated Individual Doses

Dose rates to individuals are calculated for airborne decay and deposition, inhalation, and ingestion of milk (cow and goat), meat and vegetables. Dose from plume and ground deposition are calculated as affecting all age groups equally.

Plume exposure approximately 1.25 km (0.77 mi.) SSW of the HAR produced a maximum dose rate to a single organ of 3.18 mrem/yr to skin. The maximum total body dose rate was calculated to be 5.88E-1 mrem/yr.

Ground deposition approximately 1.25 km (0.77 mi.) SSW of the HAR produced a maximum dose rate to a single organ of 1.13E-1 mrem/yr to skin. The maximum total body dose rate was calculated to be 9.62E-2 mrem/yr.

Inhalation dose at the nearest residence, 6.6 km (4.1 mi) SSW of the HAR, results in a maximum dose rate to a single organ of 9.54E-2 mrem/yr to a child's thyroid. The maximum total body dose rate is calculated to be 8.11E-3 mrem/yr to a teenager.

Vegetable consumption assumes that the dose is received from the gardens, approximately 6.6 km (4.1 mi.) SSW of the plant. GASPAR II default vegetable consumption values are used in lieu of site-specific vegetable consumption data as permitted by Regulatory Guide 1.109. The estimated maximum dose rate to a single organ is 1.08 mrem/yr to a child's thyroid. The maximum total body dose rate is calculated to be 2.37E-1 mrem/yr to a child.

Meat consumption assumes that the dose is received from an animal, approximately 5 km (3.1 mi.) SW of the HAR. GASPAR II default meat consumption values are used in lieu of site-specific meat consumption data as permitted by Regulatory Guide 1.109. The estimated maximum dose rate to a single organ is 1.18E-1 mrem/yr to a child's bone. The maximum total body dose rate is calculated to be 2.50E-2 mrem/yr to a child.

Cow milk consumption assumes that the dose is received from an animal, approximately 8.5 km (5.3 mi.) SSW of the HAR. GASPAR II default cow milk consumption values are used in lieu of site-specific cow milk consumption data as permitted by Regulatory Guide 1.109. The estimated maximum dose rate to a single organ is 0.64 mrem/yr to an infant's thyroid. The maximum body dose rate is calculated to be 1.26E-1 mrem/yr to an infant.

Goat milk consumption assumes that the dose is received from an animal, approximately 8.5 km (5.3 mi.) SSW of HAR. GASPAR II default goat milk consumption values are used in lieu of site-specific goat milk consumption data as permitted by Regulatory Guide 1.109. The estimated maximum dose rate to a single organ is 0.83 mrem/yr to an infant's thyroid. The maximum total body dose rate is calculated to be 1.38E-1 mrem/yr to an infant.

The maximum dose rate to any organ considering every pathway is calculated to be 1.86 mrem/yr to a child's bone. The maximum total body dose rate is calculated to be 1.09 mrem/yr to a child which includes the pathway doses (milk, meat, vegetable, and inhalation) plus the plume and ground deposition doses (Table 11.3-206). These are below the 10 CFR Part 50, Appendix I design objectives of 5 mrem/yr to total body, and 15 mrem/yr to any organ, including skin.

Table 11.3-201 contains GASPAR II input data for dose rate calculations. Information regarding the locations for the nearest man, milk animal, garden, school, and the EAB is located in Section 2.3. Table 11.3-206 contains total

organ dose rates based on age group. Table 11.3-207 contains total air dose at each special location.

11.3.3.4.2 Estimated Population Dose

HAR COL 11.3-1

The estimated population dose within 81 km (50 miles) is calculated as 6.5 person-rem whole body and 12.9 person-rem thyroid.

11.3.3.6 Quality Assurance

Add the following to the end of DCD Subsection 11.3.3.6:

STD SUP 11.3-1

Since the impact of radwaste systems on safety is limited, the extent of control required by Appendix B to 10 CFR Part 50 is similarly limited. Thus, a supplemental quality assurance program applicable to design, construction, installation, and testing provisions of the gaseous radwaste system is established by procedures that complies with the guidance presented in Regulatory Guide 1.143.

11.3.5 COMBINED LICENSE INFORMATION

11.3.5.1 Cost Benefit Analysis of Population Doses

HAR COL 11.3-1

This section adopts NEI 07-11 (Reference 201). This document is currently under review by the NRC staff. The augments provided in NEI 07-11 were evaluated and were found not to be cost beneficial due to the low HAR population doses.

11.3.6 REFERENCES

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201. NEI 07-11, “Generic Template Guidance for Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors,” Revision 0, September 2007.

HAR COL 11.3-1
HAR COL 11.5-3

Table 11.3-201
GASPAR II Input for Dose Rates

Input Parameter	Value
Number of Source Terms	1
Distance from site to NE Corner of the United States (mi.)	1100
Source Term	DCD Table 11.3-3
Population Data	Table 11.3-202
Fraction of the year leafy vegetables are grown	0.42
Fraction of the year milk cows are on pasture	0.67
Fraction of max individual's vegetable intake from own garden	1.0
Fraction of milk-cow feed intake from pasture while on pasture	1.0
Fraction of the year goats are on pasture	0.75
Fraction of goat feed intake from pasture while on pasture	1.0
Fraction of the year beef cattle are on pasture	0.67
Fraction of beef-cattle feed intake from pasture while on pasture	1.0
Total Production Rate for the 50-mile area	
-Vegetables (kg/yr)	Table 11.3-203
-Milk (L/yr)	Table 11.3-204
-Meat (kg/yr)	Table 11.3-205
Special Location Data	Section 2.3

HAR COL 11.3-1
HAR COL 11.5-3

Table 11.3-202 (Sheet 1 of 2)
Population Data

Population Data	Distance (mi)									
Direction	1	2	3	4	5	10	20	30	40	50
N	1	40	149	158	209	1601	35,620	198,100	33,700	17,020
NNE	0	36	218	299	304	14,000	40,360	65,160	29,160	16,510
NE	0	42	147	162	250	22,770	193,700	271,800	59,930	28,970
ENE	1	9	36	43	42	12,630	137,100	195,600	57,570	28,860
E	0	5	21	25	191	16,250	50,220	57,790	41,980	30,060
ESE	0	6	7	52	93	14,770	29,920	28,020	39,740	21,830
SE	0	6	5	25	93	3570	18,480	40,010	23,560	13,120
SSE	0	1	5	3	33	1348	10,360	12,740	11,730	20,300
S	0	0	0	1	3	420	7167	25,700	151,700	152,200
SSW	0	0	2	20	45	846	11,030	17,240	13,220	34,610
SW	0	0	7	28	33	425	34,720	13,690	27,340	43,790
WSW	0	0	10	30	93	1341	7896	5981	9826	12,320
W	0	1	43	99	108	1554	3705	9992	11,270	55,930

HAR COL 11.3-1
HAR COL 11.5-3

Table 11.3-202 (Sheet 2 of 2)
Population Data

Population Data	Distance (mi)									
Direction	1	2	3	4	5	10	20	30	40	50
WNW	0	11	52	87	117	383	6337	12,830	18,200	39,210
NW	3	31	55	76	76	655	9931	10,030	54,220	95,200
NNW	3	610	79	36	50	409	53,010	48,480	38,030	12,790

HAR COL 11.3-1
HAR COL 11.5-3

Table 11.3-203 (Sheet 1 of 2)
Vegetable Production

Vegetable Production (kg/yr)	Distance (mi)									
Direction	1	2	3	4	5	10	20	30	40	50
S	484	1300	1840	1650	2110	88,100	483,000	825,000	1,400,000	1,500,000
SSW	484	1300	1630	1650	2110	77,700	453,000	744,000	321,000	73,900
SW	484	1300	1650	1650	2110	84,600	429,000	523,000	447,000	573,000
WSW	484	1130	1200	1650	2110	89,000	316,000	349,000	421,000	526,000
W	484	913	1190	1650	2110	28,100	74,200	115,000	281,000	431,000
WNW	484	354	1190	1650	2110	1,7500	69,400	120,000	271,000	463,000
NW	484	991	1190	1650	2110	17,500	69,500	159,000	259,000	411,000
NNW	484	1260	469	1650	2110	17,500	73,800	2,810,000	203,000	285,000
N	484	1300	2110	2640	2990	20,600	65,000	106,000	158,000	119,000
NNE	484	1300	2110	2930	3740	30,900	107,000	117,000	590,000	951,000
NE	484	1300	2110	2930	3740	30,900	123,000	204,000	616,000	1,290,000
ENE	484	1300	2110	2930	3740	30,900	123,000	204,000	509,000	8,200,000

HAR COL 11.3-1
HAR COL 11.5-3

Table 11.3-203 (Sheet 2 of 2)
Vegetable Production

Vegetable Production (kg/yr)	Distance (mi)									
Direction	1	2	3	4	5	10	20	30	40	50
E	484	1300	2110	2930	3740	30,900	128,000	901,000	1,670,000	3,680,000
ESE	484	1300	2110	2930	3740	30,900	322,000	1,190,000	1,670,000	2,410,000
SE	484	1300	2110	2930	4200	89,800	480,000	858,000	4,070,000	8,880,000
SSE	484	1300	2110	2350	4690	120,000	483,000	841,000	2,090,000	5,470,000

HAR COL 11.3-1
HAR COL 11.5-3

Table 11.3-204 (Sheet 1 of 2)
Milk Production

Milk Production (l/yr)	Distance (mi)									
Direction	1	2	3	4	5	10	20	30	40	50
S	725	1940	5620	15,900	20,400	140,000	523,000	802,000	374,000	519,000
SSW	725	1940	7530	15,900	20,400	124,000	456,000	780,000	544,000	793,000
SW	725	1940	7360	15,900	20,400	119,000	403,000	465,000	344,000	455,000
WSW	725	3490	11,400	15,900	20,400	115,000	486,000	631,000	605,000	528,000
W	725	5410	11,500	15,900	20,400	161,000	666,000	1,110,000	3,130,000	4,850,000
WNW	725	5660	11,500	15,900	20,400	168,000	670,000	1,060,000	2,340,000	4,960,000
NW	725	4710	11,500	15,900	20,400	168,000	684,000	1,200,000	574,000	2,630,000
NNW	725	2240	9640	15,900	20,400	168,000	1,070,000	2,810,000	3,190,000	1,330,000
N	725	1940	3150	6990	12,400	140,000	553,000	1,270,000	2,280,000	1,790,000
NNE	725	1940	3160	4380	5600	46,300	225,000	524,000	960,000	1,440,000
NE	725	1940	3160	4380	5600	46,300	184,000	306,000	538,000	728,000

HAR COL 11.3-1
HAR COL 11.5-3

Table 11.3-204 (Sheet 2 of 2)
Milk Production

Milk Production (l/yr)	Distance (mi)									
Direction	1	2	3	4	5	10	20	30	40	50
ENE	725	1940	3160	4380	5600	46,300	184,000	306,000	415,000	578,000
E	725	1940	3160	4380	5600	46,300	184,000	246,000	309,000	554,000
ESE	725	1940	3160	4380	5600	46,300	204,000	224,000	309,000	710,000
SE	725	1940	3160	4380	6030	102,000	520,000	778,000	650,000	963,000
SSE	725	1940	3160	9600	18,700	132,000	523,000	755,000	432,000	723,000

HAR COL 11.3-1
HAR COL 11.5-3

Table 11.3-205 (Table 1 of 2)
Meat Production

Meat Production (kg/yr)	Distance (mi)									
Direction	1	2	3	4	5	10	20	30	40	50
S	3200	8560	50,700	192,000	246,000	1,980,000	8,080,000	12,400,000	5,780,000	8,300,000
SSW	3200	8560	79,300	192,000	246,000	1,590,000	6,620,000	12,900,000	11,800,000	9,520,000
SW	3200	8560	76,800	192,000	246,000	1,540,000	546,000	11,700,000	20,200,000	25,200,000
WSW	3200	31,700	138,000	192,000	246,000	1,510,000	6,280,000	12,800,000	20,200,000	19,900,000
W	3200	60,500	139,000	192,000	246,000	1,950,000	8,050,000	13,400,000	21,800,000	29,400,000
WNW	3200	2340	139,000	192,000	246,000	2,030,000	8,080,000	12,900,000	16,600,000	18,700,000
NW	3200	50,000	139,000	192,000	246,000	2,030,000	7,990,000	5,980,000	7,540,000	6,890,000
NNW	3200	13,100	3100	192,000	246,000	2,030,000	5,560,000	2,810,000	4,650,000	6,330,000
N	3200	8560	14,400	58,400	126,000	1,610,000	4,650,000	2,860,000	3,960,000	4,780,000
NNE	3200	8560	13,900	19,300	24,700	204,000	1,040,000	2,590,000	2,850,000	3,670,000
NE	3200	8560	13,900	19,300	24,700	204,000	81,2000	1,350,000	2,790,000	5,600,000
ENE	3200	8560	13,900	19,300	24,700	204,000	812,000	1,350,000	3,290,000	9,390,000

HAR COL 11.3-1
HAR COL 11.5-3

Table 11.3-205 (Table 2 of 2)
Meat Production

Meat Production (kg/yr)	Distance (mi)									
Direction	1	2	3	4	5	10	20	30	40	50
E	3200	8560	13,900	19,300	24,700	204,000	850,000	6,170,000	11,500,000	13,600,000
ESE	3200	8560	13,900	19,300	24,700	204,000	2,670,000	8,240,000	11,500,000	32,500,000
SE	3200	8560	13,900	19,300	34,000	1,390,000	8,030,000	12,700,000	36,700,000	80,900,000
SSE	3200	8560	13,900	97,500	234,000	2,030,000	8,080,000	11,700,000	13,100,000	44,900,000

HAR COL 11.5-3

Table 11.3-206
Individual Dose Rates[a]

	Dose (mrem/yr)							
Age Group	**Total Body**	**GI-Tract**	**Bone**	**Liver**	**Kidney**	**Thyroid**	**Lung**	**Skin**
Adult	8.13E-01	2.25E-01	5.65E-01	2.26E-01	2.24E-01	5.71E-01	2.24E-01	2.38E-01
Teenager	8.71E-01	2.82E-01	8.36E-01	2.87E-01	2.84E-01	7.87E-01	2.83E-01	2.96E-01
Child	1.09E+00	4.96E-01	1.86E+00	5.07E-01	5.01E-01	1.43E+00	4.97E-01	5.10E-01
Infant	9.52E-01	3.61E-01	1.19E+00	3.79E-01	3.70E-01	1.65E+00	3.64E-01	3.78E-01

a) Dose rates represent the summation of dose rates from each pathway (milk, vegetable, inhalation, meat).

HAR COL 11.5-3

Table 11.3-207
Dose in Millirads at Special Locations

Special Location	Beta Air Dose	Gamma Air Dose
EAB	4.47	9.70E-01
Nearest Residence/Garden	4.80E-01	8.31E-02
Nearest Cow/Goat Milk	3.46E-01	5.83E-02
Nearest Meat Animal	4.71E-01	8.72E-02

11.4 SOLID WASTE MANAGEMENT

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

11.4.5 QUALITY ASSURANCE

Add the following to the end of DCD Subsection 11.4.5:

STD SUP 11.4-1

Since the impact of radwaste systems on safety is limited, the extent of control required by Appendix B to 10 CFR Part 50 is similarly limited. Thus, a supplemental quality assurance program applicable to design, construction, installation and testing provisions of the solid radwaste system is established by procedures that complies with the guidance presented in Regulatory Guide 1.143.

11.4.6 COMBINED LICENSE INFORMATION FOR SOLID WASTE MANAGEMENT SYSTEM PROCESS CONTROL PROGRAM

Add the following information to the end of DCD Subsection 11.4.6.

This COL Item is addressed below.

STD COL 11.4-1

This section adopts NEI 07-10 (Reference 201) which is currently under review by the NRC staff. The PCP describes the administrative and operational controls used for the solidification of liquid or wet solid waste and the dewatering of wet solid waste. Its purpose is to provide the necessary controls such that the final disposal waste product meets applicable federal regulations (10 CFR Parts 20, 50, 61, 71, and 49 CFR Part 173), state regulations, and disposal site waste form requirements for burial at a low level waste (LLW) disposal site that is licensed in accordance with 10 CFR Part 61.

Waste processing (solidification or dewatering) equipment and services may be provided by the plant or by third-party vendors. Each process used meets the applicable requirements of the PCP.

No additional onsite radwaste storage is required beyond that described in the DCD.

Table 13.4-201 provides milestones for PCP implementation.

11.4.6.1 Procedures

STD SUP 11.4-1

Operating procedures specify the processes to be followed to ship waste that

complies with the waste acceptance criteria (WAC) of the disposal site, 10 CFR 61.55 and 61.56, and the requirements of third party waste processors.

Each waste stream process is controlled by procedures that specify the process for packaging, shipment, material properties, destination (for disposal or further processing), testing to verify compliance, the process to address non-conforming materials, and required documentation.

Where materials are to be disposed of as non-radioactive waste (as described in DCD Subsection 11.4.2.3.3), final measurements of each package are performed to verify there has not been an accumulation of licensed material resulting from a buildup of multiple, non-detectable quantities. These measurements are obtained using sensitive scintillation detectors, or instruments of equal sensitivity, in a low-background area.

Procedures document maintenance activities, spill abatement, upset condition recovery, and training.

Procedures document the periodic review and revision, as necessary, of the PCP based on changes to the disposal site, WAC regulations, and third party PCPs.

11.4.6.2 Third Party Vendors

Third party equipment suppliers and/or waste processors are required to supply approved PCPs. Third party vendor PCPs describe compliance with Regulatory Guide 1.143, Generic Letter 80-09, and Generic Letter 81-39. Third party vendor PCPs are referenced appropriately in the plant PCP before commencement of waste processing.

11.4.7 REFERENCES

201. NEI 07-10, “Generic FSAR Template Guidance for Process Control Program (PCP) Description,” Revision 1, October 2007.

11.5 RADIATION MONITORING

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

11.5.1.2 Power Generation Design Basis

Add the following information after the fourth bullet in DCD Subsection 11.5.1.2.

STD COL 11.5-2

- Data collection and data storage to support compliance reporting for the applicable NRC requirements and guidelines, such as General Design Criterion 64 and Regulatory Guide 1.21 and Regulatory Guide 4.15, Revision 1.

11.5.2.4 Inservice Inspection, Calibration, and Maintenance

Add the following information at the end of DCD Subsection 11.5.2.4:

STD COL 11.5-2

Daily checks of effluent monitoring system operability are made by observing channel behavior. Detector response is routinely observed with a remotely-positioned check source in accordance with plant procedures. Instrument background count rate is also observed to determine proper functioning of the monitors. Any detector whose response cannot be verified by observation during normal operation or by using the remotely-positioned check source can have its response checked with a portable check source. A record is maintained showing the background radiation level and the detector response.

Calibration of the continuous radiation monitors is done with commercial radionuclide standards that have been standardized using a measurement system traceable to the National Institute of Standards and Technology.

11.5.3 EFFLUENT MONITORING AND SAMPLING

Add the following information at the end of DCD Subsection 11.5.3.

HAR COL 11.5-2

Progress Energy is extending the existing Shearon Harris program for quality assurance of radiological effluent and environmental monitoring that is based on Regulatory Guide 4.15, Revision 1, to apply to Shearon Harris Nuclear Power Plant, Units 2 and 3. Regulatory Guide 4.15, Revision 1, is a proven methodology for quality assurance of radiological effluent and environmental monitoring programs that is acceptable to the NRC staff as a method for demonstrating compliance with applicable requirements of 10 CFR Parts 20, 50,

52, 61, and 72. Use of Revision 2 of Regulatory Guide 4.15 would necessitate conducting two separate programs involving the use of common staff, facilities and equipment, which will create an undue burden and may lead to an increased possibility for human error. Therefore, Progress Energy commits to use Regulatory Guide 4.15, Revision 1, methodology for Shearon Harris Nuclear Power Plant, Units 2 and 3 for optimal consistency, efficiency and practicality.

11.5.4 PROCESS AND AIRBORNE MONITORING AND SAMPLING

STD COL 11.5-2 Add the following information at the end of the first paragraph in DCD Subsection 11.5.4.

The sampling program for liquid and gaseous effluents will conform to Regulatory Guide 4.15, Revision 1 (See Appendix 1AA).

Add the following information at the end of DCD Subsection 11.5.4.

11.5.4.1 Effluent Sampling

STD COL 11.5-2 Effluent sampling of potential radioactive liquid and gaseous effluent paths is conducted on a periodic basis to verify effluent processing meets the discharge limits to offsite areas. The effluent sampling program provides the information for the effluent measuring and reporting required by 10 CFR 50.36a and 10 CFR Part 20 and implemented through the Offsite Dose Calculation Manual (ODCM) and plant procedures. The frequency of the periodic sampling and analyses described herein are nominal and may be increased as permitted by procedure. Tables 11.5-201 and 11.5-202 summarize the sample and analysis schedules and sensitivities, respectively. The information contained in Tables 11.5-201 and 11.5-202 are derived from Regulatory Guide 1.21.

Laboratory isotopic analyses are performed on continuous and batch effluent releases in accordance with the ODCM. Results of these analyses are compiled and appropriate portions are utilized to produce the Radioactive Effluent Release Report.

11.5.4.2 Representative Sampling

The pressure head of the fluid, if available, is used for taking samples. If sufficient pressure head is not available to take samples, then sample pumps are used to draw the sample from the process fluid to the detector panels and back to the process.

For obtaining representative samples in unfiltered ducts, isokinetic probes are used as recommended by ANSI N13.1 (Reference 201).

Analytical Procedures

Typically, samples of process and effluent gases and liquids are analyzed in the station laboratory or by an outside laboratory via the following techniques:

- Gross alpha/beta counting
- Gamma spectrometry
- Liquid scintillation counting

"Available" instrumentation and counting techniques change as other instruments and techniques become available. For this reason, the frequency of sampling and the analysis of samples are generalized in this subsection.

Gross alpha/beta analysis may be performed directly on unprocessed samples (e.g., air filters) or on processed samples (e.g., evaporated liquid samples). Sample volume, counting geometry, and counting time are chosen to match measurement capability with sample activity. Correction factors for sample detector geometry, self-absorption and counter resolving time are applied to provide the required accuracy.

Liquid effluent samples are prepared for alpha/beta counting by evaporation onto steel planchets. Gamma analysis may be done on any type of sample (gas, solid or liquid) in a gamma spectrometer.

Tritiated water vapor samples are collected by condensation or adsorption, and the resultant liquid is analyzed by liquid scintillation counting techniques.

Radiochemical separations are used for the routine analysis of Sr-89 and Sr-90.

Liquid samples are collected in polyethylene bottles to minimize absorption of nuclides onto container walls.

11.5.6.5 Quality Assurance

Add the following information at the end of DCD Subsection 11.5.6.5.

STD COL 11.5-2 The sampling program and the associated monitors conform to Regulatory Guide 4.15, Revision 1 (See Appendix 1AA).

11.5.7 COMBINED LICENSE INFORMATION

STD COL 11.5-1 This section adopts NEI 07-09 (Reference 202), which is currently under review by NRC staff. The ODCM program description contains the methodology and parameters used for calculating doses resulting from liquid and gaseous

effluents. The ODCM program description addresses operational setpoints, including planned discharge rates, for radiation monitors and monitoring programs (process and effluent monitoring and environmental monitoring) for the control and assessment of the release of radioactive material to the environment. The ODCM program description provides the limitations on operation of the radwaste systems, including functional capability of monitoring instruments, concentrations of effluents, sampling, analysis, 10 CFR Part 50, Appendix I dose and dose commitments, and reporting. The ODCM program description will be finalized prior to fuel load with site-specific information.

Table 13.4-201 provides milestones for ODCM implementation.

STD COL 11.5-2

This COL Item is addressed in Subsections 11.5.1.2, 11.5.2.4, 11.5.4, 11.5.4.1, 11.5.4.2, and 11.5.6.5.

HAR COL 11.5-2

This COL item is addressed in Subsection 11.5.3.

HAR COL 11.5-3

This COL Item is addressed in Subsection 11.2.3.5 and 11.3.3.4 for liquid and gaseous effluents, respectively.

Add the following subsection after DCD Subsection 11.5.7.

11.5.8 REFERENCES

201. ANSI N13.1-1999, “Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities.”

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202. NEI 07-09, “Generic FSAR Template Guidance for Offsite Dose Calculation Manual (ODCM) Program Description,” Revision 0, September 2007.

STD COL 11.5-2

Table 11.5-201 (Sheet 1 of 2)
Minimum Sampling Frequency

Stream	Sampled Medium	Frequency
Gaseous	Continuous Release	A sample is taken within one month of initial criticality, and at least weekly thereafter to determine the identity and quantity for principal nuclides being released. A similar analysis of samples is performed following each refueling, process change, or other occurrence that could alter the mixture of radionuclides.
		When continuous monitoring shows an unexplained variance from an established norm.
		Monthly for tritium.
	Batch Release	Prior to release to determine the identity and quantity of the principal radionuclides (including tritium).
	Filters (particulates)	Weekly.
		Quarterly for Sr-89, Sr-90, and Fe-55.
		Monthly for gross alpha.

STD COL 11.5-2

Table 11.5-201 (Sheet 2 of 2)
Minimum Sampling Frequency

Stream	Sampled Medium	Frequency
Liquid	Continuous Releases	Weekly for principal gamma-emitting radionuclides. Monthly, a composite sample for tritium and gross alpha. Monthly, a representative sample for dissolved and entrained fission and activation gases. Quarterly, a composite sample for Sr-89, Sr-90, and Fe-55.
	Batch Releases	Prior to release for principal gamma-emitting radionuclides. Monthly, a composite sample for tritium and gross alpha. Monthly, a representative sample from at least one representative batch for dissolved and entrained fission and activation gases. Quarterly, a composite sample for Sr-89, Sr-90 and Fe-55.

STD COL 11.5-2

Table 11.5-202
Minimum Sensitivities

Stream	Nuclide	Sensitivity
Gaseous	Fission & Activation Gases	1.0E-04 µCi/cc
	Tritium	1.0E-06 µCi/cc
	Iodines & Particulates	Sufficient to permit measurement of a small fraction of the activity that would result in annual exposures of 15 mrem to thyroid for iodines, and 15 mrem to any organ for particulates, to an individual in an unrestricted area.
	Gross Radioactivity	Sufficient to permit measurement of a small fraction of the activity that would result in annual air dose of 1) 10 mrad due to gamma, and 2) 20 mrad of beta at any location near ground level at or beyond the site boundary.
Liquid	Gross Radioactivity	1.0E-07 µCi/ml
	Gamma-emitters	5.0E-07 µCi/ml
	Dissolved & Entrained Gases	1.0E-05 µCi/ml
	Gross Alpha	1.0E-07 µCi/ml
	Tritium	1.0E-05 µCi/ml
	Sr-89 & Sr-90	5.0E-08 µCi/ml
	Fe-55	1.0E-06 µCi/ml